

Eye Care for Patients in Critical Care Units (vented patients)

Darren G. Gregory, MD
University of Colorado Health Sciences Center
Department of Ophthalmology — Rocky Mountain Lions Eye Institute

Introduction

Patients in critical care areas are at increased risk for developing ocular complications, most commonly as a result of excessive exposure and drying of the surface of the eye. A number of factors can contribute to this problem. Proper, simple eye care measures can decrease the incidence of sight-threatening infections and scarring that can yield long-term problems for a patient who was otherwise successfully treated during their time in a critical care unit. Additionally, for patients who are terminally ill, proper eye care will help maintain the health of the corneal tissue and preserve the option of eye donation for the patient or the patient's family members.

Ocular Anatomy and Immune Defense

Clear vision requires light to be precisely focused on the nerve layer (retina) that lines the internal aspect of the posterior eye wall. Approximately 70% of this focusing is accomplished by the cornea — the clear dome over the central portion of the front of the eye. Any scarring or distortion of the central cornea or the tear film coating the cornea will yield blurring of the vision. Any significant disruption of the tear film not only blurs vision but also places the underlying corneal tissue at risk for infection and subsequent permanent scarring.

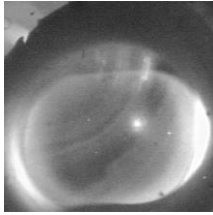
The cornea is an avascular structure composed mainly of precisely arranged collagen fibers and glycosaminoglycans. It depends on the constant turnover of the tear film via blinking to protect it from infection. Tears contain a number of substances that have antimicrobial properties, such as lysozyme and immunoglobulins. Additionally, the thin layer of epithelium covering the cornea provides a potent barrier to microbial invasion. The health of this avascular epithelium is dependent on the supply of oxygen and nutrients provided by tears. A stagnant tear film and drying of the corneal surface decrease the antimicrobial effect, weaken the epithelial barrier and allow increased localized bacterial infection. Breaches in the epithelium expose the underlying corneal proteins to bacterial invasion, which can occur aggressively with devastating visual consequences.

Problems Specific to Critical Care Patients

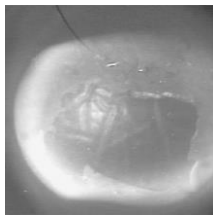
Many critical care patients are sedated, both medically and as a result of their systemic illness. Sedation decreases the blink rate and predisposes the ocular surface to desiccation. At particular risk are patients receiving mechanical ventilation. These patients are often treated with muscle relaxants that impair closure of the eyelids. During sleep, the eyelids close via active, tonic contraction of the orbicularis oculi muscle. Paralysis of these muscles brings closure to the eyelids only via passive means (i.e. gravity), and this frequently yields incomplete closure known as "lagophthalmos."

Increased jugular venous pressure from mechanical ventilation can also lead to fluid buildup, known as chemosis, under the conjunctiva — a stretchy mucous membrane covering the white part of the eyeball (sclera). This chemosis can be quite pronounced, with conjunctiva protruding over the lower eyelid. This condition can yield further impairment of passive eyelid closure and increased drying of the ocular surface. Positive end expiratory pressure (PEEP) of 5 cm H₂O and above is thought to worsen conjunctival chemosis by decreasing venous outflow from the head and neck.

Corneal infections, or infiltrates, are most commonly caused by the patient's own bacterial flora. It is important that the patient's face is kept clean and that care be taken to protect the patient's eyes when suctioning gastrointestinal or respiratory secretions. Introduction of bacterial flora from these sites onto a compromised ocular surface can yield aggressive bacterial infections.



This is a normal, healthy donor cornea seen through a slit lamp microscope with a side beam. The layers are compact; and the cornea is smooth, translucent and intact.



This donor cornea has several issues, most likely the result of poor eye care. The outer layers of the cornea, the epithelium, have become dry and opaque from exposure to the air. The lower half of the epithelial layers have sloughed away. Sloughing typically occurs below the lid line when the donor's eyes are not completely closed. The cornea has multiple, deep stromal folds, which is an indication of edema or swelling of the inner layer of the cornea, the stroma. Eye care can go a long way in preventing these issues.

Nursing Assessment

Assessment of a critical care patient's eyes should routinely be done by each nursing shift. Checking the eyes of patients who are not sedated and ventilated will allow nurses to gain an appreciation of the normal appearance of the eye. Most ocular problems in critical care patients arise from lagophthalmos, which generally increases in severity with increased sedation. It is important that eyelid position be carefully assessed. Using a penlight or flashlight will help reveal poor lid closure, which might be masked by the eyelashes. Excessive exposure can lead to breakdown of the corneal epithelium, known as keratopathy. This can be recognized as an irregular reflection of light from a penlight off the corneal surface. Lubricating ointments can also disrupt this reflection, but a gentle rinse of the ocular surface with sterile saline will rinse the ointment away. This irregular reflection of light indicates an inadequate tear film and a breakdown in the integrity of the corneal epithelium. This places the cornea at risk for infection.

Exposure keratopathy can lead to keratitis — a term for any corneal inflammation, infectious or otherwise. Bacterial keratitis in the critical care setting has an increased association with aggressive Gram(-) bacteria such as *Pseudomonas*. Once these bacteria gain entry into the subepithelial corneal collagen, rapid destruction of corneal tissue can occur. An infectious corneal ulcer will appear as a whitish area on the corneal surface. It is often accompanied by a purulent discharge. Severe dryness can also yield whitish opacities of the cornea. Therefore, an ophthalmology consultation is recommended for any new, white lesions noted on the cornea. Following infection, the orderly arrangement of corneal collagen fibers is disrupted and the resultant scar tissue yields permanent vision loss, which may require a cornea transplant for visual rehabilitation. The risk of this dire consequence may be greatly diminished if the early signs of lagophthalmos and exposure keratopathy are recognized and treated.

Nursing Interventions

Prevention of ocular complications in critical care areas begins with an awareness of the potentially devastating consequences of corneal infections. Both the evaluation and treatment of ocular surface exposure and dryness are relatively simple and minimally labor-intensive but nevertheless effective.

Each assessment of the patient by the nursing staff should include an evaluation of the adequacy of blinking and eyelid closure. If the eyes appear closed, careful inspection with a penlight or flashlight should be performed to assure the lids are, in fact, completely closed. As mentioned before, the eyelids may hide the fact that the lids are not completely closed, allowing the ocular surface to dry out.

In a sedated patient with seemingly closed eyes, the upper eyelids should be manually elevated to allow inspection of the cornea. A piece of gauze helps with manual traction of the eyelids if they are oily. Does the tear film appear uniform or is

the light reflection irregular? Sterile saline may be used to rinse away any mucous or lubricant ointment, thus allowing better assessment of the corneal surface. Any patient with signs of exposure keratopathy, lagophthalmos, or a decreased blink rate (normal blinking occurs every 5-10 seconds) should be treated every 4-6 hours with an ocular lubricating ointment such as Lacrilube. Ointments moisturize the ocular surface more effectively than drops. The ointment should be placed along the internal surface of the lower eyelid, which should then be manually closed to spread the ointment over the ocular surface. Once again, if any whitish corneal lesions or purulent discharge develops prompt ophthalmologic consultation is indicated to rule out corneal infection. A small amount of non-purulent mucous buildup is common in cases of exposure keratopathy.

In cases of significant exposure, whether from decreased blinking or poor lid closure, lubricant ointment should be applied every 4 hours. Prolapsed, chemotic conjunctiva can further worsen the exposure problems. In addition to lubricant ointment, polyethylene wrap (i.e. plastic wrap), may be placed over the skin in a strip from temple to temple, wide enough to cover the lower forehead, bridge of the nose, and upper cheeks. This will create a "moisture chamber" over the eyes. A small amount of petroleum jelly on the skin of the brow, temples and cheeks will create a tighter seal by the plastic wrap, but still allow easy removal for inspection and application of ointment. The plastic wrap should be changed each shift to lessen the risk of infection. Additionally, visitors to the patient should be briefed on the need for the plastic wrap to avoid any undue alarm.

Sensitivity of Families to the Moisture Chamber

Some family members may have increased anxiety due to the appearance of their loved one with a polyethylene moisture chamber in place. The Rocky Mountain Lions Eye Bank is very sensitive to families and their needs. It should be noted, a lot of research has shown families make decisions and rate their overall hospital experience by how they are treated and how well they are informed throughout the process. This means not only educating them about their loved one's disease process but also about the treatments and nursing care they receive. If this is done in a consistent, sensitive way without technical jargon, most families will be able to accept and understand the moisture chamber. Some may even become advocates and police its positioning. Here are some options:

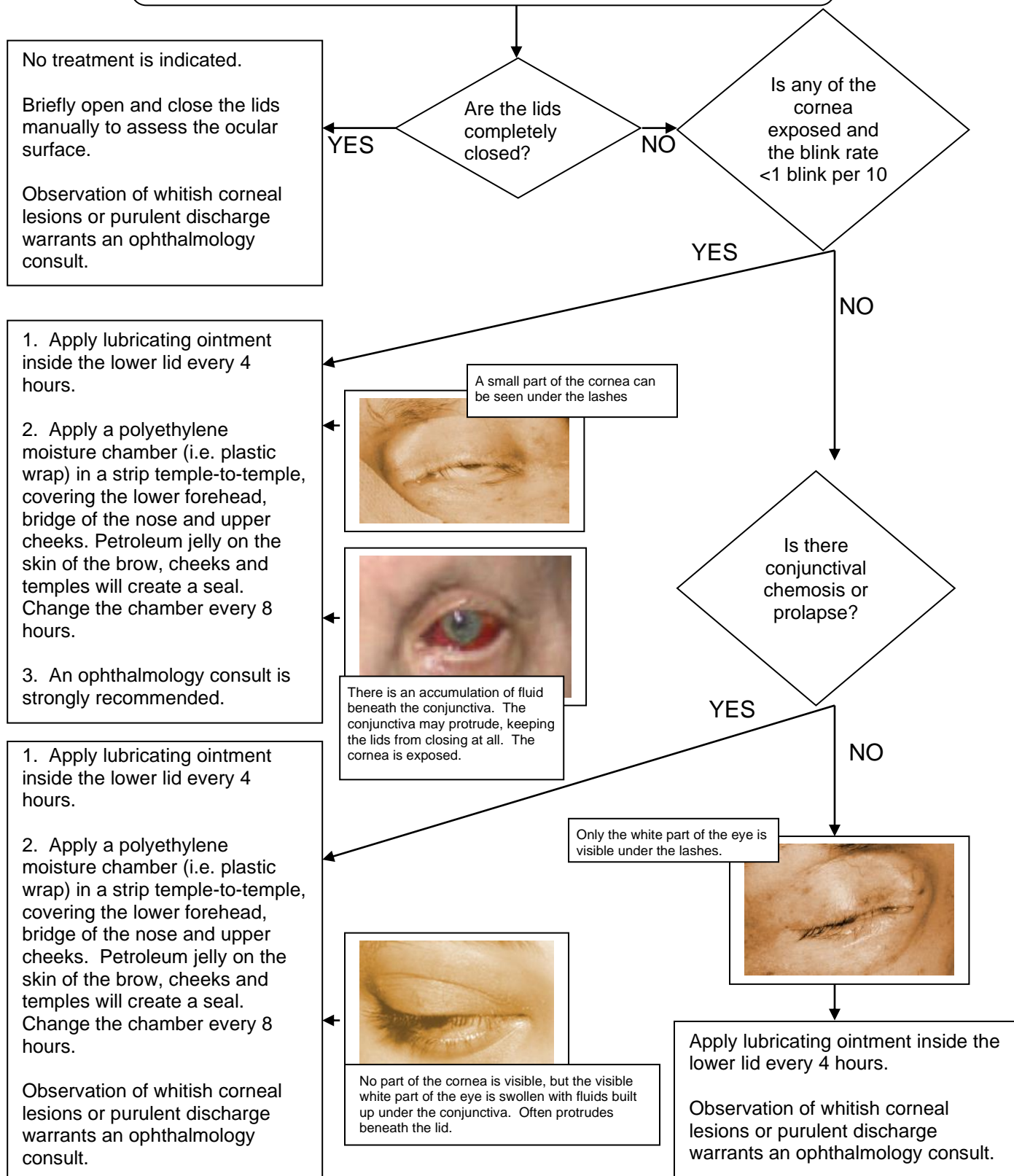
1. A simple, non-technical explanation might be: "Some of the medications he is on cause muscles to relax, including the tiny ones that close his eyes and make him blink. When this happens, the eye can dry out pretty quickly and cause him vision problems later on. This is a "moisture chamber" that traps moisture close to his eyes. We check his eyelids every shift. When his muscles can keep his eyes closed, or when he blinks more often, then we can remove it. It's only held on with petroleum jelly, so it would be good if you help keep an eye on it to make sure it hasn't shifted around or come off."
2. For families that express particular anxiety over the chamber, simply remove it during short visits. Because the moisture chamber is held in place with petroleum jelly, it is easily removed and replaced. This is not, however, a substitute for a thorough discussion with the family about the need for the moisture chamber.

Selected Bibliography

1. Cortese, D., Capp, L., McKinley, S. "Moisture Chamber Versus Lubrication for the Prevention of Corneal Epithelial Breakdown." *American Journal of Critical Care* 1995; 4: 425-8.
2. Cunningham, C., Gould, D. "Eyecare for the Sedated Patient Undergoing Mechanical Ventilation: the Use of Evidence-Based Care." *International Journal of Nursing Studies* 1998; 35: 32-40.
3. Dua, H. "Bacterial Keratitis in the Critically Ill and Comatose Patient." *Lancet* 1998; 351: 387-8.
4. Farrek, M., Wray, F. "Eyecare for Ventilated Patients." *Intensive and Critical Care Nursing* 1993; 9: 137-41.
5. Hernandez, E., Mannis, M. "Superficial Keratopathy in Intensive Care Unit Patients." *American Journal of Ophthalmology* 1997; 124: 212-6.
6. Lenart, S., Garrity, J. "Eye Care for Patients Receiving Neuromuscular Blocking agents or Propofol during Mechanical Ventilation." *American Journal of Critical Care* 2000; 9: 188-91.
7. McClellan, K. "Mucosal Defense of the Outer Eye." *Survey of Ophthalmology* 1997; 42: 233-46.
8. Mercieca, F., Suresh, P., Morton, A., et al. "Ocular Surface Disease in Intensive Care Unit Patients." *Eye* 1999; 13: 231-6.
9. Parkin, B., Turner, A., Moore, E., et al. "Bacterial Keratitis in the Critically Ill." *British Journal of Ophthalmology* 1997; 81: 1060-3.
10. Suresh, P., Mercieca, F., Morton, A., et al. "Eye Care for the Critically Ill." *Intensive Care Medicine* 2000; 26: 162-6.

Eye Care Decision Tree for Unconscious/Sedated Patients on a Ventilator

Using a penlight, assess the degree of ocular surface exposure. A close examination is necessary to see beneath the lashes, which can hide incomplete eyelid closure. This assessment should be made each nursing shift or every 8 hours for each patient.



Application of a Polyethylene Moisture Chamber

Make sure the patient's face is clean and that lubricating ointments have been instilled prior to application of a moisture chamber



1. Apply a small amount of petroleum jelly to your fingertip.

2. Apply the petroleum jelly from temple to temple, across the forehead, bridge of the nose and upper cheekbones. (indicated by the red line in the photo)



3. Apply a 4-6 inch wide strip of plastic wrap over the area. Press film into the petroleum jelly at the forehead, then smooth around the petroleum jelly line. The chamber should not be tight over the eyes.

4. The chamber should be changed every 8 hours. It may be easily lifted or removed for eye examination and for family visits in cases where the chamber causes family members increased anxiety. Every effort should be made to explain the role of the moisture chamber in preserving the patient's sight.



How to Apply Lubricating Ointments to the Eye



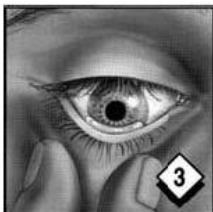
Thoroughly wash and dry hands.



Gently pull the lower lid downward to expose the conjunctival sac and form a pocket. You may use a cotton-tipped swab to roll the upper lid open to access the lower lid if necessary.



Squeeze a ribbon of ointment into the pocket just inside the lower lid. Avoid touching the tip of the medication bottle or tube to the eye to avoid the transfer of micro-organisms to the medication and injury to the eye. Do not push on the eyeball or touch the eye. Use the cheekbone and/or forehead to steady your hands.



Very gently, pinch the lower lid and move gently upward to disperse some of the ointment onto the cornea.



Close the eyes completely. A cotton swab can be helpful to roll the upper lid downward. Do not pull on the edge of the lid. Do not tape closed. Ensure that no part of the cornea is visible beneath the eye lid. Repeat every 8 hours.